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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : A61K 38/24, 31/575, A61P 15/08

A1

(11) International Publication Number: WO 00/50065

(43) International Publication Date: 31 August 2000 (31.08.00)

(21) International Application Number: PCT/DK00/00073

(22) International Filing Date: 23 February 2000 (23.02.00)

(30) Priority Data:

PA 199900256	24 February 1999 (24.02.99)	DK
60/130,662	23 April 1999 (23.04.99)	US
PA 199901307	16 September 1999 (16.09.99)	DK

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(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published

With international search report.

Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: TREATMENT OF INFERTILITY

(57) Abstract

In an *in vitro* fertilisation method, a woman is treated with a hypothalamic hormone and/or a pituitary hormone or an agonist or antagonist thereof or an active derivative thereof for a short period of time and, thereafter, using *in vitro* oocyte maturation egg or eggs are retrieved from the woman and are maturated using a meiosis activating compound.

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TREATMENT OF INFERTILITY

FIELD OF THIS INVENTION

This invention relates to an improved method of *in vitro* fertilisation (hereinafter designated IVF).

BACKGROUND OF THIS INVENTION

Since the first IVF pregnancy was delivered in 1978, this procedure has resulted in thousands of pregnancies and opened a vast new frontier of research and treatment for the infertile couples. Still, there is a significant need for improved infertility treatment modalities today. It is presumed that about one out of seven couples experience problems with subfertility or infertility.

IVF of human oocytes has become commonly used for the treatment of female and male subfertility. The standard IVF treatment includes a long phase of hormone stimulation of the female patient, e.g. 30 days, which is initiated by suppressing the patient's own follicle stimulating hormone (hereinafter designated FSH) and luteinising hormone (hereinafter designated LH) by gonadotropin releasing hormone (hereinafter designated GnRH), and this is followed by injections of exogenous gonadotropins, e.g. FSH and/or LH, in order to ensure development of multiple preovulatory follicles and aspiration of multiple *in vivo* matured oocytes immediately before ovulation. The aspirated oocyte is subsequently fertilised *in vitro* and cultured, typically for three days before transferral back into the uterus at the 4-8 cell stage. Continuous efforts have been made to optimise and simplify this procedure. Nevertheless, the overall pregnancy rate cannot be increased significantly over about 20% with the current treatment modalities. In a large European survey of IVF patients, it was found that 7.2 oocytes out of 11.5 aspirated oocytes per patient had undergone resumption of meiosis immediately before fertilisation, only 4.3 oocytes were fertilised and only 2.2 oocytes reached the 8-cell embryo stage after fertilisation and *in vitro* culture (ESHRE, Edinburgh, 1997).

Due to the very unpredictable quality of the state of the art embryos today, more than one embryo has to be transferred just to give a reasonable chance of success. Therefore, it is common to transfer 2-3 embryos (up to 5 embryos in some countries), which carries the very large side effect of multiple pregnancies with great discomfort and risk to both patient and children. Moreover, it has been estimated that the increased health care expenses due to multiple birth (twins, triplets etc.) is exceeding the entire IVF expenses.

Hence, there are several disadvantages with the current treatment, the four most notable being:

1. the risk of ovarian hyperstimulation with injecting gonadotropins which is a potential fatal condition that requires hospitalisation,
2. multiple pregnancies (50-1.000 times the normal frequency of twins and triplets, respectively),
3. the existence of considerable patient segments that do not tolerate the current method due to, e.g. polycystic ovarian syndrome and many diabetics, and
4. a potential long-term cancer risk.

Furthermore, weight gain, bloating, nausea, vomiting, labile mood and other patient discomforts together with patient reluctance to inject themselves are reported as disadvantages.

It is known from WO 96/00235 that certain sterol derivatives can be used for regulating meiosis. An example of such a sterol is 4,4-dimethyl-5α-cholesta-8,14,24-triene-3β-ol (hereinafter designated FF-MAS).

Herein, the term MAS compounds designates compounds which mediate the meiosis of oocytes. More specifically, MAS compounds are compounds which in the test described in Example 1 below has a percentage germinal vesicle breakdown (hereinafter designated GVB) which is significantly higher than the control. Preferred MAS compounds are such having a percentage GVB of at least 50%, preferably at least 80%.

Examples of MAS compounds are mentioned in WO 96/00235, 96/27658, 97/00884, 98/28323, 98/54965 and 98/55498, more specifically in Claim 1 thereof.

In WO 95/000265, some potential meiosis regulating substances were tested on immature female mice. 48 hours before the test animal were killed by cervical dislocation, they were given a single injection of human menopausal gonadotropin containing 20 IU FSH and 20 IU LH. The ovaries were removed, placed in a hypoxanthine medium and freed of extraneous tissue. Then, the oocytes were punctured out of the follicles, freed from cumulus cells and cultured in a medium containing a meiosis regulating derivative.

At present, *in vitro* maturation in humans has proven highly unsuccessful despite substantial interest and clinical efforts.

One object of the present invention is to treat human infertility.

Another object of the present invention is to improve the maturation of her human oocytes.

Another object of the present invention is to improve the synchrony of nuclear, cytoplasmic and/or membranous oocyte maturation.

Another object of the present invention is to improve the fertility of oocytes.

Another object of the present invention is to improve the rate of implantation of oocytes by human *in vitro* maturation and fertilisation.

Another object of the present invention is to diminish the incidence of human preembryos with chromosome abnormalities (aneuploidy).

Another object of the present invention is to improve the cleavage rate of human preembryos.

Another object of the present invention is to improve the quality of human preembryos.

SUMMARY OF THIS INVENTION

It has now, surprisingly, been found that the IVF treatment and the degree of side effects can be improved substantially if the woman, within a consecutive period of 30 days, avoids treatment with a hypothalamic hormone and/or a pituitary hormone or an agonist or antagonist thereof or an active derivative thereof (hereinafter this treatment is designated exogeneous stimulation) or if the exogeneous stimulation treatment of the female is only for a short period of time, e.g. less than 7 days, preferably less than 4 days. Using this improved method involving less or no exogeneous stimulation, a MAS compound is used to actively mature and synchronise human oocytes *in vitro*, leading to fertilisation and embryo development.

Briefly, the present invention relates to a method for human *in vitro* fertilisation wherein a woman, within a consecutive period of 30 days, is treated with a hypothalamic hormone and/or a pituitary hormone or an agonist or antagonist thereof or an active derivative thereof for a period which is less than about 7 days, preferably less than about 4 days, and, thereafter, using *in vitro* oocyte maturation wherein immature egg or eggs are retrieved from the woman and are *in vitro* matured in a synchronize manner using a MAS compound as defined herein. Preferred embodiments of this invention are those stated in the sub claims below.

DETAILED DESCRIPTION OF THIS INVENTION

Referring to the female cycle, one way of performing the IVF treatment of this invention is as follows:

Around days 6-9 in the cycle: Stimulation with FSH, e.g. 75-600 IU per day, preferably 150-225 IU per day, e.g. for 3 days.

Around day 9: The eggs are retrieved from the woman using ultrasound guided aspiration of small to medium size follicles with a diameter of about 6-12 mm, preferably 8-10 mm.

Around day 9-11: The eggs are maturated with a MAS compound in order to stimulate the meiosis. In this maturation step, the concentration of MAS compound may be in the range of about 0.1-100 μmol per litre, e.g. 10-20 μmol per litre. This medium may contain human serum albumin (hereinafter designated HSA), e.g. 0.8 %, and it may additionally contain some ethanol, e.g., 0.4%, which has been used to dissolve MAS. The time for this maturation step may be in the range around 15-60 hours, e.g., about 22-40 hours, more specifically about 30-36 hours.

Around days 11-13: The eggs are fertilised *in vitro*.

Around days 12-16: The eggs are cultured *in vitro* in a suitable medium.

From the day before aspiration, the woman will receive an oestrogen, e.g. oestrogen valerate (2 x 10 mg daily). Two days later, she will also receive a progestogen, e.g., Progestane vagetoria, daily, which will render the lining of the uterus more prone to receive the future embryos. The duration of this treatment will be individually designed per patient. The doctor can chose among a variety of oestrogens and progestogens.

Around day 15-16: One or more embryos are transferred to the woman's uterus.

Hence, all in all, the complete treatment takes about 10-15 days.

Referring to the female cycle, another way of performing the IVF treatment of this invention is as follows:

Around days 2-8 in the cycle: Stimulation with FSH, e.g. 75-600 IU per day, preferably 150-225 IU per day, e.g. for 3 days, eventually spread over 6 days.

Around day 7-9: The eggs are retrieved from the woman using ultrasound guided aspiration of small to medium size follicles with a diameter of about 6-15 mm, preferably 8-12 mm.

Around day 7-11: The eggs are maturated with a MAS compound in order to stimulate the meiosis. In this maturation step, the concentration of MAS compound may be in the range of about 0.01-100 µmol per litre, e.g., 5-20 µmol per litre. This medium may contain human serum albumin (hereinafter designated HSA), e.g. 0.8 %, and it may additionally contain some ethanol, e.g., 0.1-0.4%, which has been used to dissolve MAS. The time for this maturation step may be in the range around 15-60 hours, e.g., about 22-40 hours, more specifically about 30-36 hours.

Around days 9-13: The eggs are fertilised *in vitro.*

Around days 10-16: The eggs are cultured *in vitro* in a suitable medium.

From the day before aspiration, the woman will receive an oestrogen, e.g. oestrogen valerate (2 x 10 mg daily). Two days later, she will also receive a progestogen, e.g., Progestane vagetoria, daily, which will render the lining of the uterus more prone to receive the future embryos. The duration of this treatment will be individually designed per patient. The doctor can chose among a variety of oestrogens and progestogens.

Around day 13-16: One or more embryos are transferred to the woman's uterus.

Hence, all in all, the complete treatment takes about 10-15 days.

Most of the steps in the above treatment and procedure are performed in a known manner and the remaining steps are performed in a manner known per se. More details about the removal of the oocytes from follicles in the ovary, culturing of the isolated oocytes, the culture medium to be used, the fertilisation with sperm, and the

transfer of the embryo to the fallopian tube can be found in the literature, for example, in US patent specification No. 5,693,534 which is hereby incorporated by reference.

According to this invention, the MAS compound is added to the culture medium used. In this medium, the amount of the MAS compound is in the range from about 0.01 to about 100 μM, preferably in the range from about 0.1 to about 100 μM.

The reduced risk of side effects makes the method according to the present invention an attractive alternative to the current methods where GnRH is used for about 22 days and FSH is used for about 9 days before the eggs are retrieved and, thereafter, a progestogen is used for several weeks. Hence, using the treatment according to the present invention, the period in which the female patient is treated with a hypothalamic hormone and/or a pituitary hormone is reduced by about 80-90%. The total period of treatment by the current methods is about 4 weeks. Hence, using the treatment according to the present invention, the total period of treatment is reduced by about 50-60%.

Hypothalamic hormones are hormones present in the human hypothalamus. Pituitary hormones are hormones present in the human pituitary gland. Gonadotropic hormones are hormones secreted by the anterior lobe of the pituitary in vertebras and by mammalian placenta, which control the activity of gonads. Chemically, they are glycoproteins. Examples of gonadotropic hormones are FSH, LH and chorion gonadotropin, e.g. human chorion gonadotropin (hereinafter designated hCG). FSH stimulates growth of ovarian follicles and their oocytes in ovary and the formation of spermatozoa in testis. FSH can, e.g., be menopausal FSH or recombinant FSH. In females, LH activates the oestrogen-producing tissue of the ovaries to produce progesterone, probably promotes the final stages of the development of ovarian follicles, initiates the final oocyte maturation, induces ovulation and in mammals initiates corpus luteum development. These hormones are known. It is obvious for the skilled art worker that, alternatively, agonists or antagonists of these hormones can be used. It is also obvious for the skilled art worker that, alternatively, active analogues of these hormones can be used. Some of these agonists, antagonists and analogues are

known and other can be prepared by process known per se. Examples of such known processes are chemical synthesis and genetic engineering.

In a preferred embodiment, the present invention relates to a method or use wherein the period in which said woman is treated with a hypothalamic hormone and/or a pituitary hormone or an agonist or antagonist thereof or an active derivative thereof is 0 (zero) days.

In a further preferred embodiment, the present invention relates to a method or use wherein the woman is treated for infertility, and/or for improving the maturation of her oocytes, and/or for improving the synchrony of nuclear, cytoplasmic and/or membranous oocyte maturation, and/or for improving the fertility of her oocytes, and/or for improving the rate of implantation of her oocytes by human *in vitro* maturation and fertilisation.

In a further preferred embodiment, the present invention relates to a method or use wherein the consecutive period is one menstrual cycle.

In a further preferred embodiment, the present invention relates to a method or use wherein the hormones are gonadotropic releasing hormones or an agonist or antagonist thereof or analogues thereof or gonadotropic hormones or an agonist or antagonist thereof or analogues thereof.

In a further preferred embodiment, the present invention relates to a method or use wherein the gonadotropic hormone is FSH or an agonist or antagonist thereof or analogues thereof.

In a further preferred embodiment, the present invention relates to a method or use wherein the period in which the female patient is treated with FSH or an agonist or antagonist thereof or analogues thereof, prior to the retrieval of the egg, is less than 7 days, preferably less than 4 days, and is at least 1 day.

In a further preferred embodiment, the present invention relates to a method or use wherein the period in which the female patient is treated with FSH or an agonist or antagonist thereof or analogues thereof is 2, 3 or 4 days.

In a further preferred embodiment, the present invention relates to a method or use wherein no chorion gonadotropin, e.g. human chorion gonadotropin or an agonist or antagonist thereof or analogues thereof is used.

In a further preferred embodiment, the present invention relates to a method or use wherein no gonadotropic releasing hormone, e.g. GnRH, or an agonist or antagonist thereof or analogues thereof is used.

In a further preferred embodiment, the present invention relates to a method or use wherein the dosage of MAS compound is in the range from about 0.01 μM per litre to about 100 μM per litre, preferably in the range from about 0.1 μM per litre to about 100 μM per litre.

In a further preferred embodiment, the present invention relates to a method or use wherein the MAS compound is one of the compounds mentioned in WO 96/00235, 96/27658, 97/00884, 98/28323, 98/54965 and 98/55498, more specifically compounds mentioned in Claim 1 thereof.

In a further preferred embodiment, the present invention relates to a method or use wherein the MAS compound is FF-MAS.

Additionally, the present invention relates to the use of a hypothalamic hormone and/or a pituitary hormone or an agonist or antagonist thereof or an active derivative thereof in the manufacture of a hormone product which is to be administered to a woman who, within a consecutive period of 30 days, is treated with a hypothalamic hormone and/or a pituitary hormone or an agonist or antagonist thereof or an active derivative thereof for a period which is less than about 7 days, preferably less than about 4 days, and from whom, immediately after said period, one or more oocytes

are aspirated, where after said oocyte(s) is/are cultivated in a convenient medium containing a MAS compound as defined herein, where after said oocyte(s) is/are fertilised with human sperm, and, where after, the resulting embryo(s) is/are transferred to a woman.

Additionally, the present invention relates to use of a hypothalamic hormone and/or a pituitary hormone or an agonist or antagonist thereof or an active derivative thereof and of a MAS compound for the manufacture of a medicament for the treatment of human *in vitro* fertilisation wherein a hypothalamic hormone and/or a pituitary hormone or an agonist or antagonist thereof or an active derivative thereof is, within a consecutive period of 30 days, used to treat a women for a period which is less than about 7 days, preferably less than about 4 days, and, thereafter, the MAS compound is used in an *in vitro* oocyte maturation of the egg or eggs retrieved from this woman.

Additionally, the present invention relates to a pharmaceutically kit in unit dosage form for use by *in vitro* fertilisation comprising 1-8 separate unit dosages, said kit comprising less than 7, preferably less than 4, and at least 1 separate dosage units for sequential daily administration of a hypothalamic hormone and/or a pituitary hormone or an agonist or antagonist thereof or an active derivative thereof for sequential daily administration and 1 dosage units of a MAS compound. This kit may have the preferred features described above.

The present invention is further illustrated by the following examples, which, however, are not to be construed as limiting. The features disclosed in the foregoing description, in the following examples and in the claims may, both separately and in any combination thereof, be material for realising the invention in diverse forms thereof.

Example 1

Method used for electing MAS compounds

Oocytes were obtained from immature female mice (C57BL/6J x DBA/2J F1, Bomholtgaard, Denmark) weighing 13-16 grams, that were kept under controlled temperature (20-22 °C), light (lights on 06.00-18.00) and relative humidity (50-70%). The mice received an intra-peritoneal injection of 0.2 ml gonadotropins (Gonal-F, Serono) containing 20 IU FSH and 48 hours later the animals were killed by cervical dislocation. The ovaries were dissected out and the oocytes were isolated in Hx-medium (see below) under a stereomicroscope by manual rupture of the follicles using a pair of 27 gauge needles. Spherical oocytes displaying an intact germinal vesicle (hereinafter designated GV) were divided in cumulus enclosed oocytes (hereinafter designated CEO) and naked oocytes (hereinafter designated NO) and placed in α-minimum essential medium (α-MEM without ribonucleosides, Gibco BRL, Cat. No. 22561) supplemented with 3 mg/ml bovine serum albumin (BSA, Sigma Cat. No. A-7030), 5 mg/ml human serum albumin (HSA, Statens Seruminstitut, Denmark), 0.23mM pyruvate (Sigma, Cat. No S-8636), 2 mM glutamine (Flow Cat. No. 16-801), 100 IU/ml penicillin and 100 µg/ml streptomycin (Flow, Cat No. 16-700). This medium was supplemented with 3 mM hypoxanthine (Sigma Cat. No. H-9377) and designated Hx-medium. The oocytes were rinsed three times in Hx-medium and oocytes of uniform size were divided into groups of CEO and NO. CEO and NO were cultured in 4-well multidishes (Nunclon, Denmark) in which each well contained 0.4 ml of Hx-medium and the compound to be tested in a concentration of 10 µM. One control well (i.e., 35-45 oocytes cultured in identical medium with no addition of test compound) was always cultured simultaneously with 3 test wells (35-45 oocytes per well supplemented with test compound). The oocytes were cultured in a humidified atmosphere of 5% CO_2 in air for 24 hours at 37°C. By the end of the culture period, the number of oocytes with GV, GVB and polar bodies (hereinafter designated PB), respectively, were counted using a stereo microscope (Wildt, Leica MZ 12). The percentage of GVB, defined as percentage of oocytes undergoing GVB per total number of oocytes in that well, was calculated as:

% GVB = ((number of GVB + number of PB)/ total number of oocytes) X 100.

Example 2

Patients for *in vitro* fertilisation (IVF) normally undergo a long (4 weeks) gonadotropin based protocol that leads to the aspiration of *in vivo* matured oocytes. These oocytes are subsequently fertilised *in vitro* and replaced as 4-8 cell embryos to the uterus of the patient by a cervical catheter.

In vitro maturation with FF-MAS

Procedure

All IVF patients can potentially receive this treatment, age range 20 to 45 year with or without displaying Polycystic ovarian syndrome (PCO) and with or without a regular cycle. In the case of irregular cycle or amemorhea (no cyclic activity) this procedure could be preceded with oral contraceptive for various lengths (1-10 month) and withdrawn upon initiation of the following procedure. In the beginning (day 1-6, preferably day 3-6) of the cycle (day 1 = 1st day of menses), the patient will be clinically examined and may or may not receive a small priming FSH stimulus individually designed for each patient (length: 1-7 days, doses: 75 IU to 750 IU, preferentially 3-4 days with doses 150 to 300 IU recombinant or urinary based FSH) with or without the use of GNRH antagonist and with or without hCG. Small to medium size follicles (size: 4 to 16 mm, preferential 8 to 12 mm follicles) will be aspirated under ultrasound guidance using a low/reduced suction pressure and specially designed (more rigid) needles. The aspirated fluid will be searched for cumulus oocytes complexes (COC) and once identified under the stereomicroscope (with or without the use of embryo filters), the COC will be placed in culture. A wide variety of oocyte culture media or media components known to the skilled worker can be used, however the oocytes will be induced to resume meiotic maturation by exposure to FF-MAS. Human serum albumin (HSA) may or may not be added to the medium. If added, it can be in a concentration of 0.1 to 100 mg/ml, preferentially 5 to 15 mg/ml or 0.5 to 1.5 % (volume/volume. The formulation of FF-MAS may be in the form of an ethanol stock solution, DMSO or other organic solvent solution or it may be in form of FF-MAS/HSA dry coated wells ready to use just by adding the appropriate culture medium. The du-

ration of *in vitro* maturation may vary from 4 to 60 hours, preferentially 30 to 40 hours. The concentration of FF-MAS may vary from 0.01 μM to 100 μM, preferably from 0.1 μM to 100 μM, more preferred from 5 μM to 30 μM, even more preferred from 10 μM to 30 μM. Following *in vitro* maturation, the oocytes may be fertilised by conventional IVF or by intracytoplasmatic sperm injection (hereinafter designated ICSI) or by future appropriate fertilisation methods leading to fertilised zygotes and the developing embryo may be transferred on day 1 to day 6 after fertilisation, preferentially on day 2 to 3, either as single egg transfer or multiple egg transfer. The patient can receive progesterone and/or oestrogen therapy before and after the transfer in individually designed protocols to prime and sustain appropriate receptive endometrial lineage.

Compared with the know procedures, better results were obtained using the above procedure.

Example 3

Use of FF-MAS for *in vitro* maturation of immature human oocytes

The female patient was started on a brief ovarian stimulation with recombinant FSH with an average daily dose of 225 on day 2 in the cycle and continued for a total of three times on alternating days, i.e., 2nd, 4th, and 6th day in the cycle. At least 3 follicles of 10 mm or more on day 7 lead to aspiration of immature follicles in the size between 8-12 mm. Follicles were aspirated and immature (GV stage) cumulus enclosed oocytes were cultured in oocyte culture system containing a standard *in vitro* culture (IVC) media (IVF 20 (which is available from Scandinavian IVF Science AB, Gothenburg, Sweden)) additionally containing human serum albumin (0.8%) and FF-MAS (5 μM). All oocytes were cultured under normal conditions at 37°C in the incubator. Each oocyte was cultured in one well in a four-chamber culture dish as culture media system. The duration of exposure to the culture media with treatment was 30 hours before ICSI or *in vitro* fertilization was performed. Preembryos were evaluated for cleavage stage and fragmentation / morphology at 1, 2 and 3 days post ICSI/IVF. Af-

ter 3 days of culture, a selection of the best preembryos, typically two preembryos, were replaced to the female patient.

Compared with the know procedures, similar clinical outcome was obtained. However, in this example, compared with the known procedures, a reduced hormone exposure was used and, consequently, a reduced side effect profile was obtained here.

Example 4

Using the procedure described in Example 3 with the proviso that in stead of using FF-MAS in a concentration of 5 μM, FF-MAS was used in a concentration of 20 μM, similar clinical outcome was obtained in this procedure as was obtained with the known procedures. However, in this example, compared with the known procedures, a reduced hormone exposure was used and, consequently, a reduced side effect profile was obtained here.

CLAIMS

1. A method for human *in vitro* fertilisation wherein a woman, within a consecutive period of 30 days, is treated with a hypothalamic hormone and/or a pituitary hormone or an agonist or antagonist thereof or an active derivative thereof for a period which is less than about 7 days, preferably less than about 4 days, and, thereafter, using *in vitro* oocyte maturation wherein egg or eggs are retrieved from the woman and are matured using a MAS compound as defined herein.

2. The use of a hypothalamic hormone and/or a pituitary hormone or an agonist or antagonist thereof or an active derivative thereof in the manufacture of a hormone product which is to be administered to a woman who, within a consecutive period of 30 days, is treated with a hypothalamic hormone and/or a pituitary hormone or an agonist or antagonist thereof or an active derivative thereof for a period which is less than about 7 days, preferably less than about 4 days, and from whom, immediately after said period, one or more oocytes are aspirated, where after said oocyte(s) is/are cultivated in a convenient medium containing a MAS compound as defined herein, where after said oocyte(s) is/are fertilised with human sperm, and, where after, the resulting embryo(s) is/are transferred to a woman.

3. Use of a hypothalamic hormone and/or a pituitary hormone or an agonist or antagonist thereof or an active derivative thereof and of a MAS compound for the manufacture of a medicament for the treatment of human *in vitro* fertilisation wherein a hypothalamic hormone and/or a pituitary hormone or an agonist or antagonist thereof or an active derivative thereof is, within a consecutive period of 30 days, used to treat a women for a period which is less than about 7 days, preferably less than about 4 days, and, thereafter, the MAS compound is used in an *in vitro* oocyte maturation of the egg or eggs retrieved from this woman.

4. A method or use according to any one of the preceding clams wherein said woman is treated for infertility, and/or for improving the maturation of her oocytes, and/or for improving the synchrony of nuclear, cytoplasmic and/or membranous oocyte maturation, and/or for improving the fertility of her oocytes, and/or for im-

proving the rate of implantation of her oocytes by human *in vitro* maturation and fertilisation.

5. A method or use according to any one of the preceding claims wherein the period in which said woman is treated with a hypothalamic hormone and/or a pituitary hormone or an agonist or antagonist thereof or an active derivative thereof is 0 (zero) days.

6. A method or use according to the preceding claim wherein the consecutive period is one menstrual cycle.

7. A method or use according to any one of the preceding claims wherein the hormones are gonadotropic releasing hormones or an agonist or antagonist thereof or analogues thereof or gonadotropic hormones or an agonist or antagonist thereof or analogues thereof.

8. A method or use according to the preceding claim wherein the gonadotropic hormone is FSH or an agonist or antagonist thereof or analogues thereof.

9. A method or use according to the preceding claim wherein the period in which the female patient is treated with FSH or an agonist or antagonist thereof or analogues thereof, prior to the retrieval of the egg, is less than 7 days, preferably less than 4 days, and is at least 1 day.

10. A method or use according to the preceding claim wherein the period in which the female patient is treated with FSH or an agonist or antagonist thereof or analogues thereof is 2, 3 or 4 days.

11. A method or use according to any one of the preceding claims wherein no chorion gonadotropin, e.g. human chorion gonadotropin or an agonist or antagonist thereof or analogues thereof is used.

12. A method or use according to the previous claim wherein no gonadotropic releasing hormone, e.g. GnRH, or an agonist or antagonist thereof or analogues thereof is used.

13. A method or use according to any one of the previous claims wherein the dosage of MAS compound is in the range from about 0.01 to about 100 μM, preferably in the range from about 0.1 to about 100 μM.

14. A method or use according to any one of the previous claims, wherein the MAS compound is one of the compounds mentioned in WO 96/00235, 96/27658, 97/00884, 98/28323, 98/54965 and 98/55498, more specifically compounds mentioned in Claim 1 thereof.

15. A method or use according to the previous claim wherein the MAS compound is FF-MAS.

16. A pharmaceutically kit in unit dosage form for use by *in vitro* fertilisation comprising 1-8 separate unit dosages, said kit comprising less than 7, preferably less than 4, and at least 1 separate dosage units for sequential daily administration of a hypothalamic hormone and/or a pituitary hormone or an agonist or antagonist thereof or an active derivative thereof for sequential daily administration and 1 dosage units of a MAS compound.

17. A kit according to the previous claim having the preferred features described in any one of the above subclaims.

18. Any novel feature or combination of features described herein.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 00/00073

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: A61K 38/24, A61K 31/575, A61P 15/08
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	Human Reproduction, Volume 14, suppl 1, pages 145-161, 1999, Smitz Johan et al, "Oocyte in-vitro maturation and follicle culture: current clinical achievments and future directions", see page 150, lines 16-27 and page 155, lines 30-38	1,3-16
	--	
X	WO 9419455 A1 (GENENTECH, INC. ET AL), 1 June 1994 (01.06.94), see page 5, line 38-page 7, line 6 and page 8, lines 41-44	1-13
Y		14-16
	--	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 July 2000	24 -07- 2000
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Hampus Rystedt/EÖ Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 00/00073

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Journal of Reproductive Medicine, Volume 38, No 5, 1993, Charles M. March, M.D., "Ovulation Induction", page 335 - page 346, see section"Clomiphene citrate"and Figure 1	2,4,6-12
Y	WO 9627658 A1 (NOVO NORDISK A/S), 12 Sept 1996 (12.09.96), see page 5, lines 28-31, claim 1	14-16
Y	WO 9700883 A1 (NOVO NORDISK A/S), 12 Sept 1996 (12.09.96), see especially page 3, lines 24-26 and claim 1	14-16
Y	WO 9855498 A1 (AKZO NOBEL N.V.), 10 December 1998 (10.12.98), see page 1-3 and page 7, lines 9-10	14-16
A	WO 9828323 A1 (NOVO NORDISK A/S), 2 July 1998 (02.07.98), claim 1	1,3-16
A	WO 9700884 A1 (NOVO NORDISK A/S), 9 January 1997 (09.01.97), see page 22, lines 11-14, claim 1	1,3-16
A	WO 9600235 A1 (NOVO NORDISK A/S), 4 January 1996 (04.01.96), see claims 1, 31-35	1,3-16
A	WO 9854965 A1 (BASF AKTIENGESELLSCHAFT), 10 December 1998 (10.12.98), claim 1	14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 00/00073

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.: 1-15
because they relate to subject matter not required to be searched by this Authority, namely:

see next sheet

2. ☒ Claims Nos.: 17, 18
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

see next sheet

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).:

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see next sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 00/00073

Box I.1

A pharmaceutical composition characterized by an administration regimen is considered to be a method for treatment of the human body. Claims 1-15 relate, in part, to administration regimens and are consequently considered to be methods for treatment. In spite of this, claims 1-15 have been searched.

Box I.2

According to Article 6 PCT the claim or claims shall define the matter for which protection is sought and the claims shall be clear and concise. Simply referring to "preferred features" of previous claims or "any novel features" described in the application is not considered clear and concise. Claims 17 and 18 has only been searched for subject matter covered by claims 1-16.

Box II

According to Article 34 (3) (a-c) and Rule 13.2, an international application shall relate to one invention only or to a group of inventions linked by one or more of the same or corresponding "special technical features", i.e. features that define a contribution which each of the inventions makes over the prior art. The present application relates to two such groups of inventions, namely:

1. A method for *in vitro* fertilisation (IVF) using hormone pretreatment and subsequently *in vitro* maturation (IVM) of the oocyte with a meiosis activating compound (MAS), according to claims 1 and 13-16 (completely) and 4-12 (partially).
2. Use of a hypothalamic and/or a pituitary hormone for manufacture of a composition for use in IVF, according to claims 2 (completely) and 4-12 (partially).

The hormone composition mentioned in claim 2 can not be characterized by methodological steps that do not involve the composition itself, i.e. the treatment of oocytes with MAS. Claim 2 therefore only describes the use of a hormone for manufacture of a composition for use in IVF.
Invention 1 relates to the combined use of hormone treatment and IVM with MAS. Invention 2 relates only to hormone treatment prior to IVF, which is well known in the prior art. Inventions 1 and 2 consequently do not share any special technical features as required by Rule 13.2 PCT.

INTERNATIONAL SEARCH REPORT

Information on patent family members

02/12/99

International application No.
PCT/DK 00/00073

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9419455 A1	01/06/94	AU 672103 B	19/09/96
		AU 6249794 A	14/09/94
		CA 2154447 A	01/09/94
		EP 0686192 A	13/12/95
		JP 8507211 T	06/08/96
		US 5563059 A	08/10/96
		US 5693534 A	02/12/97
WO 9627658 A1	12/09/96	AU 4784596 A	23/09/96
		BR 9607673 A	16/06/98
		CA 2214126 A	12/09/96
		CZ 9702797 A	14/01/98
		EP 0813595 A	29/12/97
		HU 9800731 A	28/07/98
		JP 11501806 T	16/02/99
		NO 974089 A	05/09/97
		PL 322106 A	05/01/98
		US 5830757 A	03/11/98
WO 9700883 A1	12/09/96	AU 6122696 A	22/01/97
WO 9855498 A1	10/12/98	AU 8535398 A	21/12/98
WO 9828323 A1	02/07/98	AU 7878998 A	17/07/98
		EP 0946584 A	06/10/99
		NO 993009 A	19/08/99
WO 9700884 A1	09/01/97	AU 6122796 A	22/01/97
		BR 9608968 A	29/06/99
		CA 2224866 A	09/01/97
		CN 1191543 A	26/08/98
		CZ 9704080 A	17/06/98
		EP 0857173 A	12/08/98
		HU 9900454 A	28/06/99
		IL 122609 D	00/00/00
		JP 11507929 T	13/07/99
		NO 976044 A	20/02/98
		PL 324219 A	11/05/98

INTERNATIONAL SEARCH REPORT

Information on patent family members

02/12/99

International application No.
PCT/DK 00/00073

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9600235 A1	04/01/96	AU 694240 B	16/07/98
		AU 2734395 A	19/01/96
		BG 101067 A	29/08/97
		BR 9508074 A	12/08/97
		CA 2192941 A	04/01/96
		CN 1151164 A	04/06/97
		CZ 9603725 A	16/07/97
		EP 0767798 A	16/04/97
		FI 965144 A	20/02/97
		HU 76343 A	28/08/97
		HU 9603584 D	00/00/00
		IL 114294 D	00/00/00
		JP 10502060 T	24/02/98
		NO 965516 A	21/02/97
		PL 317830 A	28/04/97
		SI 9520077 A	30/06/98
		SK 165596 A	06/08/97
		US 5716777 A	10/02/98
		ZA 9505213 A	15/03/96
WO 9854965 A1	10/12/98	AU 8018798 A	21/12/98
		US 5866599 A	02/02/99